# Experiment 2: CMOS Transistor Level Current Source


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**Date: 26 February 2022**

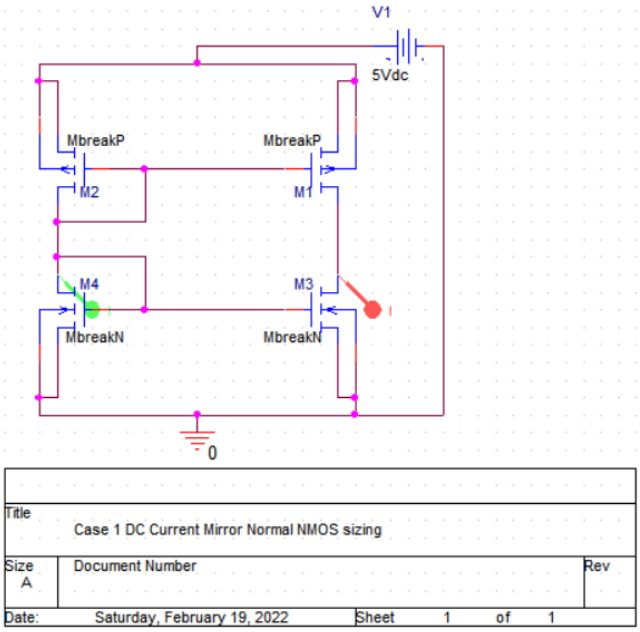
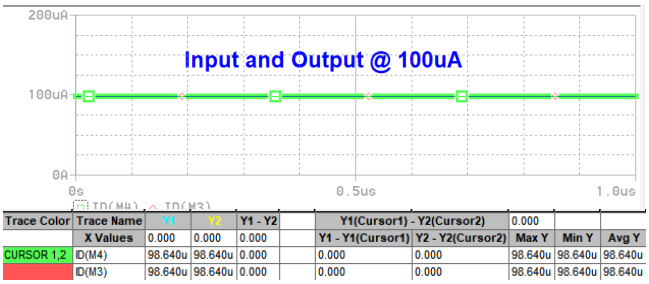



Figure 2.1: Case 1 CMOS Mirror Normal Sizing




| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | 0.000 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 0.000 | 0.000 | 0.000 | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| CURSOR 1,2 | ID(M4) | 98.640u | 98.640u | 0.000 | | 0.000 | 0.000 | 98.640u | 98.640u | 98.640u |
| | ID(M3) | 98.640u | 98.640u | 0.000 | | 0.000 | 0.000 | 98.640u | 98.640u | 98.640u |

Figure 2.2: Graphical representation of CMOS Mirror with Normal Sizing

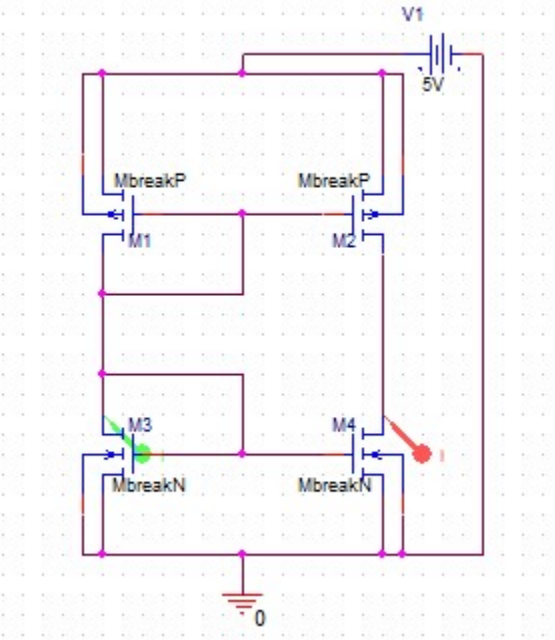
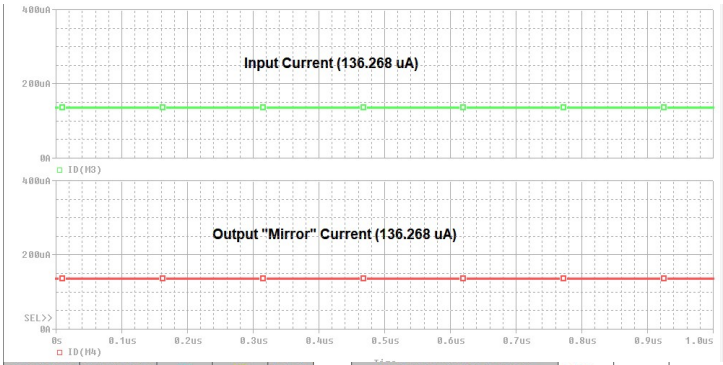
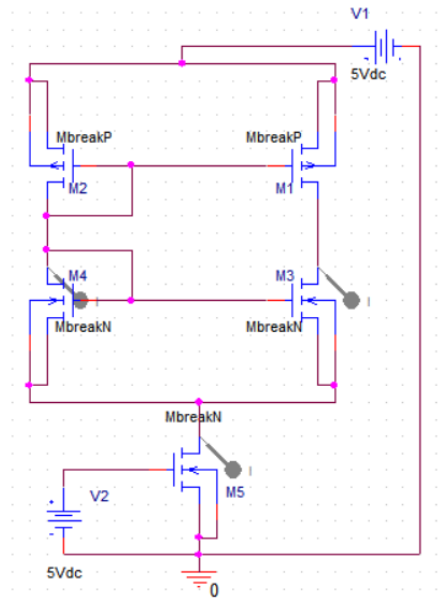



Figure 2.3: **Case 2** DC Current Mirror with Double NMOS sizing schematic



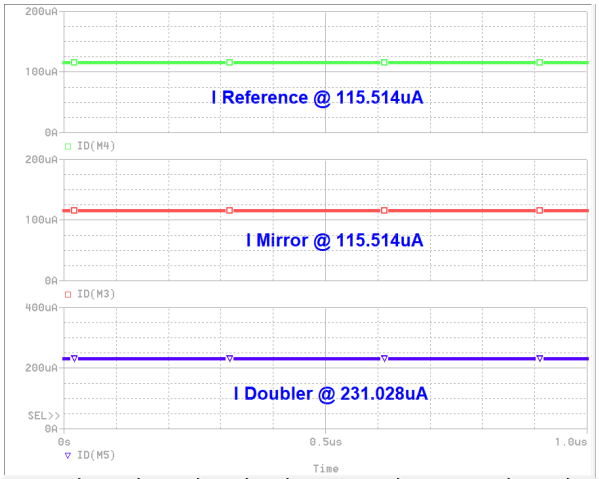

| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | 0.000 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 426.374n | 426.374n | 0.000 | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| | ID(M4) | 136.268u | 136.268u | 0.000 | | 0.000 | 0.000 | 136.268u | 136.268u | 136.268u |
| CURSOR 1,2 | ID(M3) | 136.268u | 136.268u | 0.000 | | 0.000 | 0.000 | 136.268u | 136.268u | 136.268u |

Figure 2.4: DC Current Mirror with Double NMOS sizing waveform and cursor, I/O current @ 136.268 uA




| | | | |
|---|---|---|---|
| Title | Case 3 NMOS Bias Double Sizing | | |
| Size A | Document Number | | Rev |
| Date: | Saturday, February 19, 2022 | Sheet 1 of 1 | |

Figure 2.5: Case 3 NMOS Bias Double Sizing




| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | 0.000 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 0.000 | 0.000 | 0.000 | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| CURSOR 1,2 | ID(M5) | 231.028u | 231.028u | 0.000 | | 0.000 | 0.000 | 231.028u | 231.028u | 231.028u |
| | ID(M3) | 115.514u | 115.514u | 0.000 | | -115.514u | -115.514u | 115.514u | 115.514u | 115.514u |
| | ID(M4) | 115.514u | 115.514u | 0.000 | | -115.514u | -115.514u | 115.514u | 115.514u | 115.514u |

Figure 2.6: Waveform of NMOS Bias Double Sizing

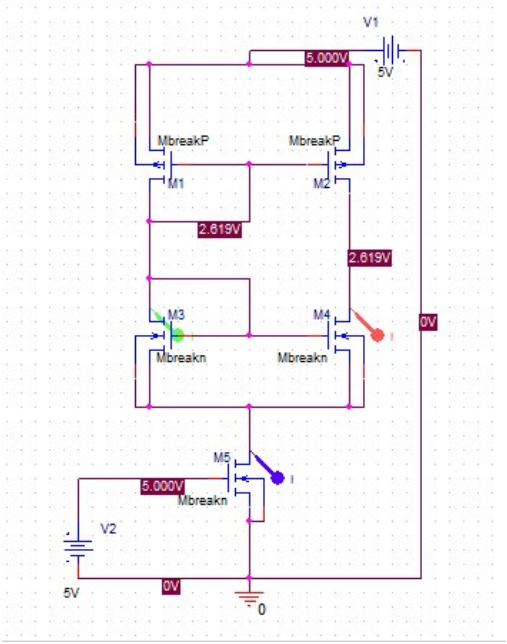
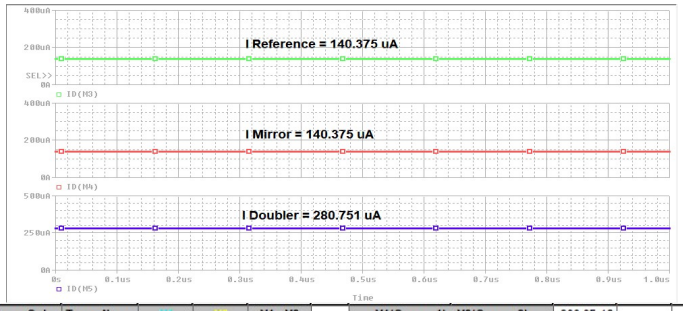



Figure 2.7: **Case 4** DC Current Mirror with Bias NMOS and 3 * (W/L) for NMOS sizing schematic




| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | -900.0E-18 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 500.000n | 0.000 | 500.000n | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| | ID(M5) | 280.751u | 280.751u | 865.500f | | 140.375u | 140.375u | 280.751u | 280.751u | 280.751u |
| | ID(M4) | 140.375u | 140.375u | 169.000f | | 0.000 | -169.900f | 140.375u | 140.375u | 140.375u |
| CURSOR 1,2 | ID(M3) | 140.375u | 140.375u | -900.0E-18 | | 0.000 | 0.000 | 140.375u | 140.375u | 140.375u |

Figure 2.8: DC Current Mirror with Bias NMOS and 3 * (W/L) for NMOS sizing waveform and cursor. Reference and Mirror currents @ 140.375 uA and Doubler current @ 280.751 uA

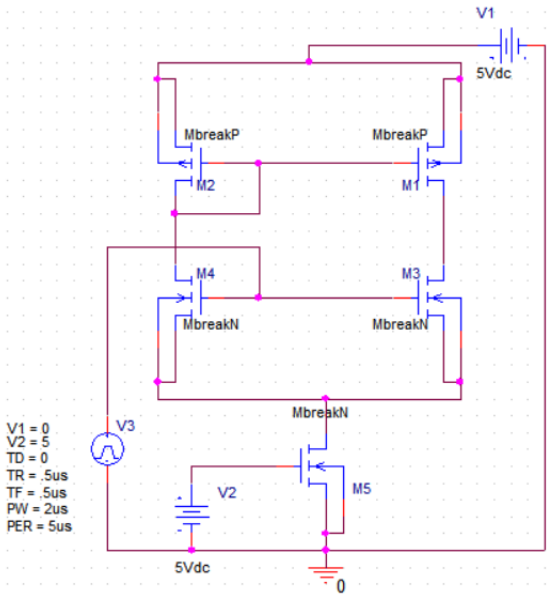
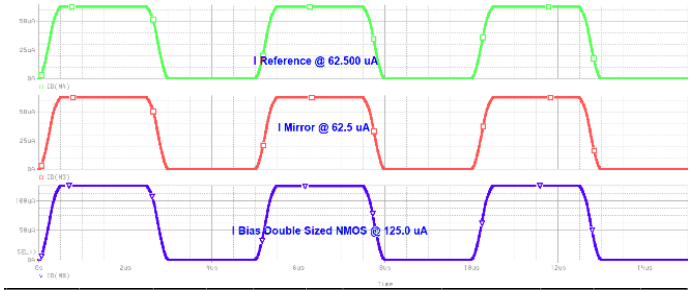



Figure 2.9: Case 5 AC Current Mirror with Bias NMOS @ 2(W/L) @ 200kHz




| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | 125.000u | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 1.9273u | 0.000 | 1.9273u | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| CURSOR 1,2 | ID(M5) | 125.000u | 10.019p | 125.000u | | 0.000 | 0.000 | 125.000u | 10.019p | 62.500u |
| | ID(M3) | 62.500u | 5.1091p | 62.500u | | -62.500u | -4.9095p | 62.500u | 5.1091p | 31.250u |
| | ID(M4) | 62.500u | 5.1091p | 62.500u | | -62.500u | -4.9095p | 62.500u | 5.1091p | 31.250u |

Figure 2.10: Graphical representation of AC current Applied to Double Sized Biased NMOS Circuit

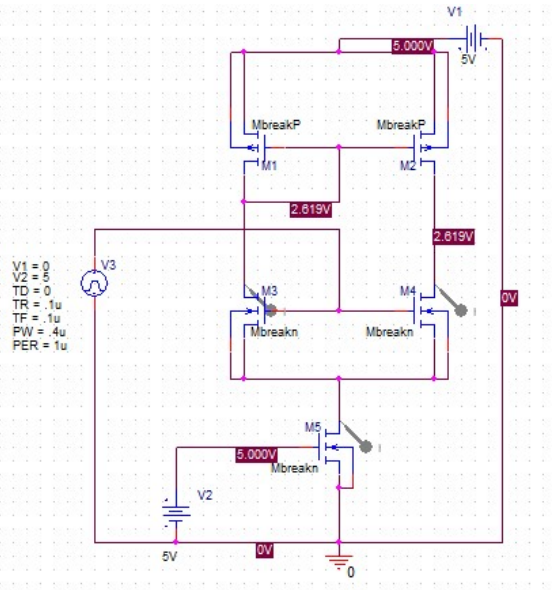
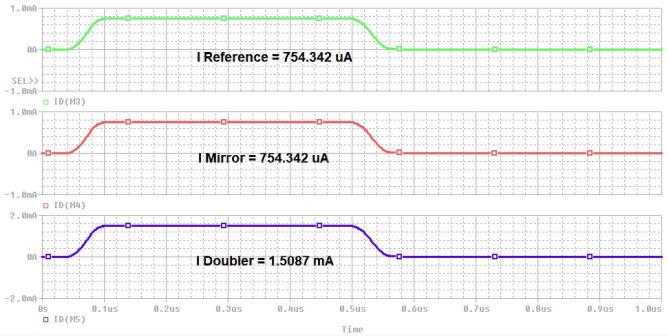



Figure 2.11: **Case 6** AC Current Mirror with Bias NMOS and 2 * (W/L) for NMOS sizing schematic, v_in(t) = 5V square wave with f = 1 MHz




| Trace Color | Trace Name | Y1 | Y2 | Y1 - Y2 | | Y1(Cursor1) - Y2(Cursor2) | | 754.342u | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X Values | 314.444n | 0.000 | 314.444n | | Y1 - Y1(Cursor1) | Y2 - Y2(Cursor2) | Max Y | Min Y | Avg Y |
| | ID(M5) | 1.5087m | 1.0538u | 1.5076m | | 754.342u | 1.0538u | 1.5087m | 1.0538u | 754.868u |
| | ID(M4) | 754.342u | 8.2645u | 746.077u | | -1.7950p | 8.2644u | 754.342u | 8.2645u | 381.303u |
| CURSOR 1,2 | ID(M3) | 754.342u | 20.140p | 754.342u | | 0.000 | 0.000 | 754.342u | 20.140p | 377.171u |

Figure 2.12: AC Current Mirror with Bias NMOS and 2 * (W/L) for NMOS sizing waveform, v_in(t) = 5V square wave with f = 1 MHz.Reference and Mirror currents @ 754.342 uA and Doubler current @ 1.5087 mA